Getting “Loopy”

Adding a 160m loop to the NR3O Antenna Farm

Background

In 2017 I decided to transition my single radio on a garage storage shelf into a fully operational hamshack.

Part of this was done with an eye toward eventual retirement.

Part was also done in self-defense, as having 2 active HF operators in the same household encounters some difficulties with a single radio and antenna. (i.e. – maintaining Marrital Bliss)

Initial Shack Goals

- 4 operator stations
- Sufficient antennas to support operations
- Contest capable
- Remote operation capable

Antenna Farm

After the initial research into available options I wound up with the following considerations:

- 4x8 antenna switch - allow up to 4 operators to select from up to (eventually) 8 antennas
- Support operations on all HF bands (6m to 160m)
- Long range, short range, horizontal and vertical antennas

Antenna Farm

- Initial antennas under consideration
  1) SteppIR beam
  2) 2nd beam / log periodic (TBD)
  3) NVIS (40/75/80 if possible)
  4) Fan Dipole
  5) Hygain AV-18HT vertical (existing – 6-160m)
  6) 160m loop

Tuning Antennas

- Most antennas have “designed” bands they are intended for. That said, they can often be used on other bands when used with a tuner.
- Other antennas are designed non-resonant and require a tuner.

160m Loop

Getting the right design

160m Loop

I chose a 160m loop for several reasons:

- Few antenna designs support 160m
- Fortunate enough to have the space/terrain
- A loop typically has one of the LOWEST noise floors of any antenna

160m Loop - Challenges

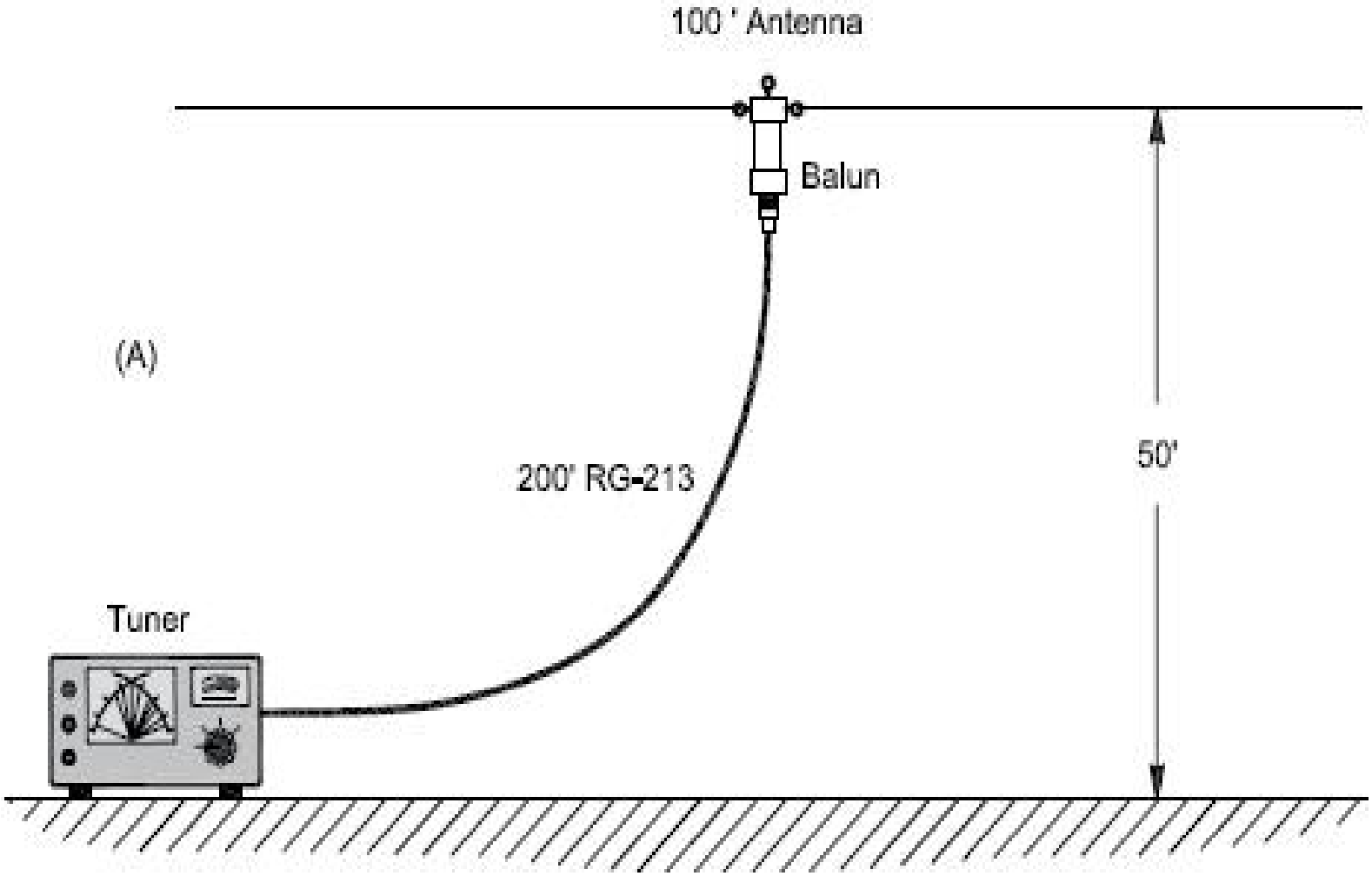
Ask 100 Hams a question and you'll get at least 50 different answers. Looking for the best 160m loop design was the same.

- Between 500' - 575' of wire
- Different heights/shapes change operating characteristics
- Feedlines / distance to shack / Baluns / tuners (oh my)
- Additional desire to use on multiple bands and full legal power added more challenges

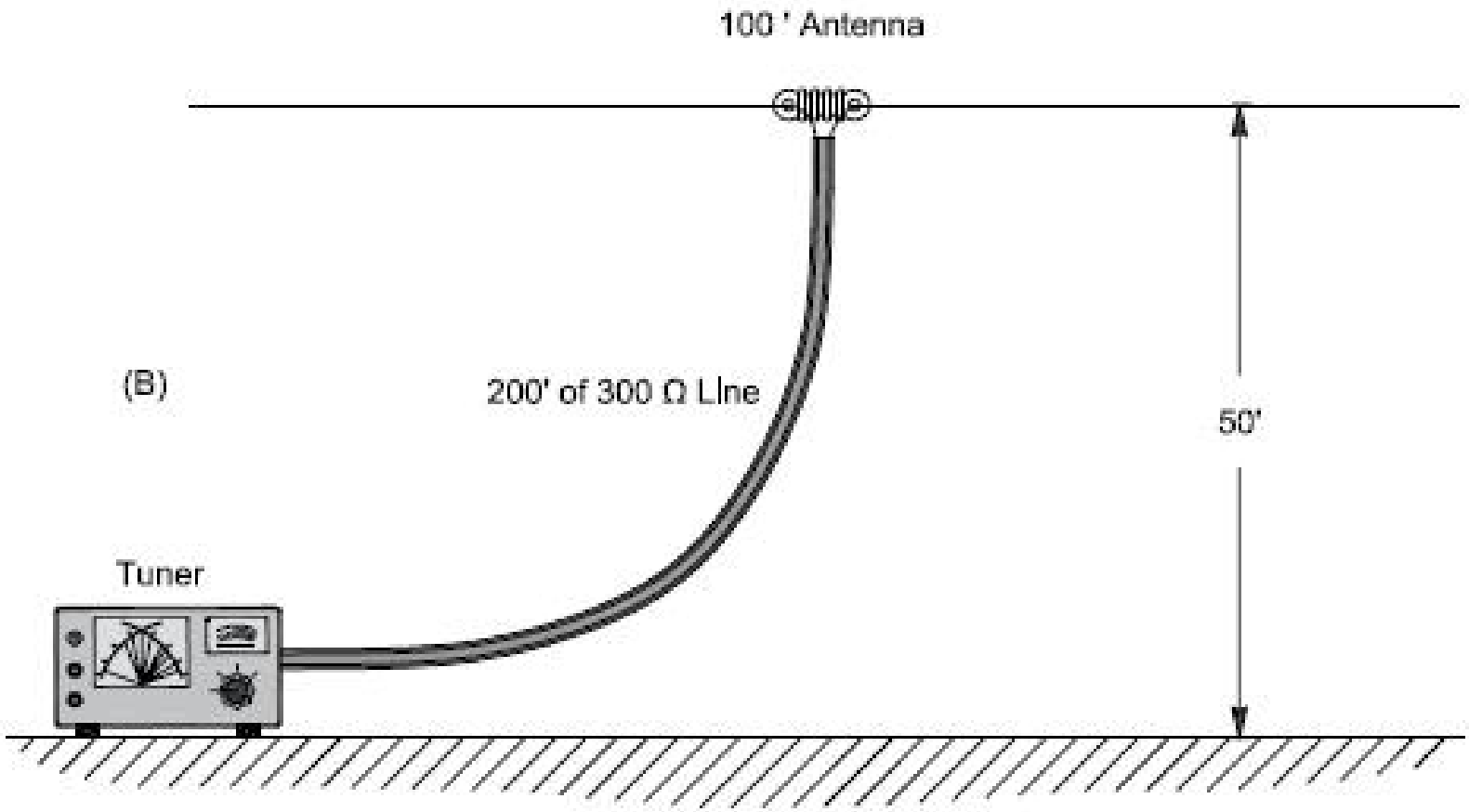
NR3O Loop

- Loop feed point is ~200’ from hamshack
- Initial loop was 500’ long
- 25’ of 450 ohm ladder-line from feed point to coax junction box
- DX Engineering Balun transition from ladder line to coax
- ~ 180’ of LMR-400 from tower on hill down to shack
- Loop operates up to 1500 watts

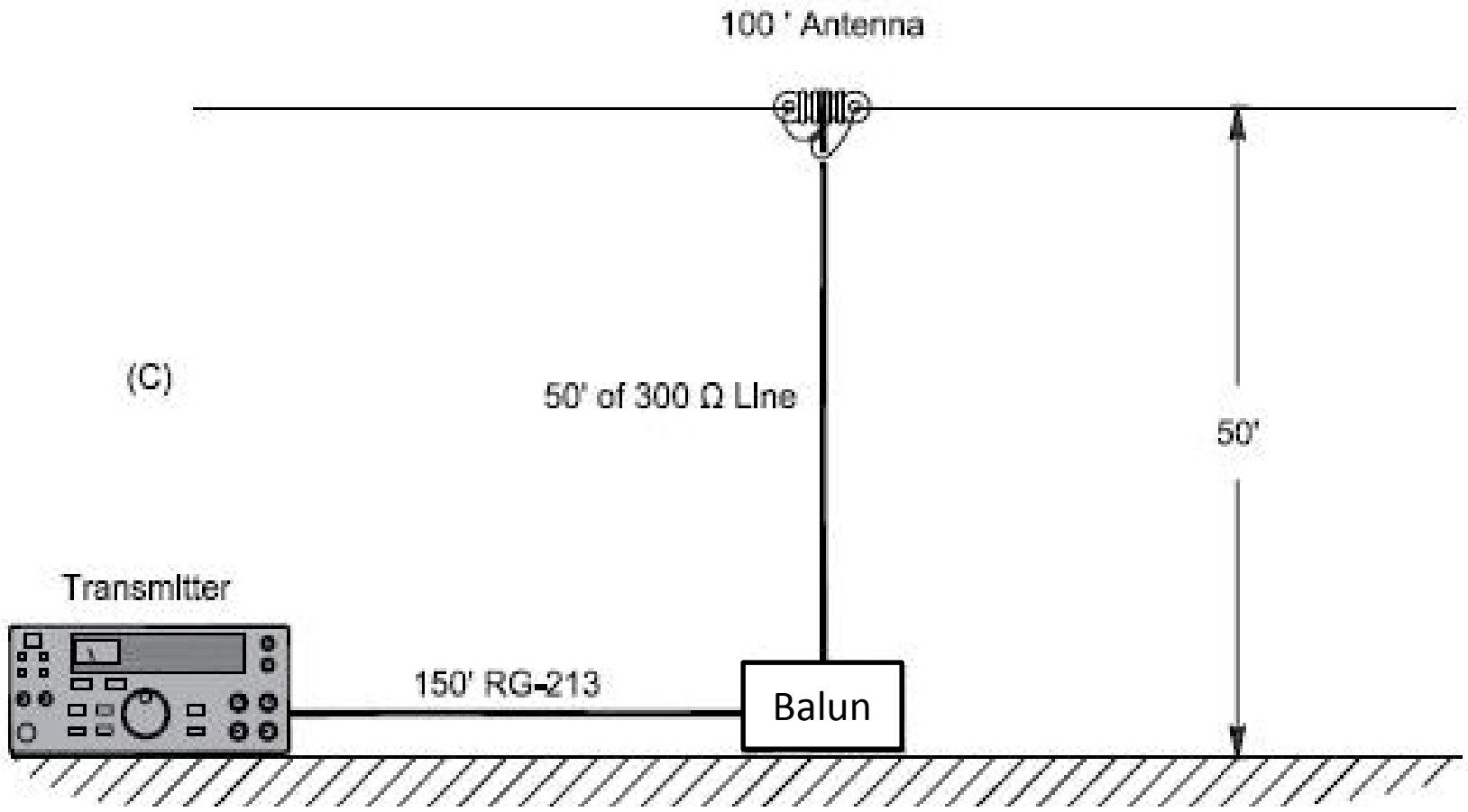
Possible Feedlines - #1



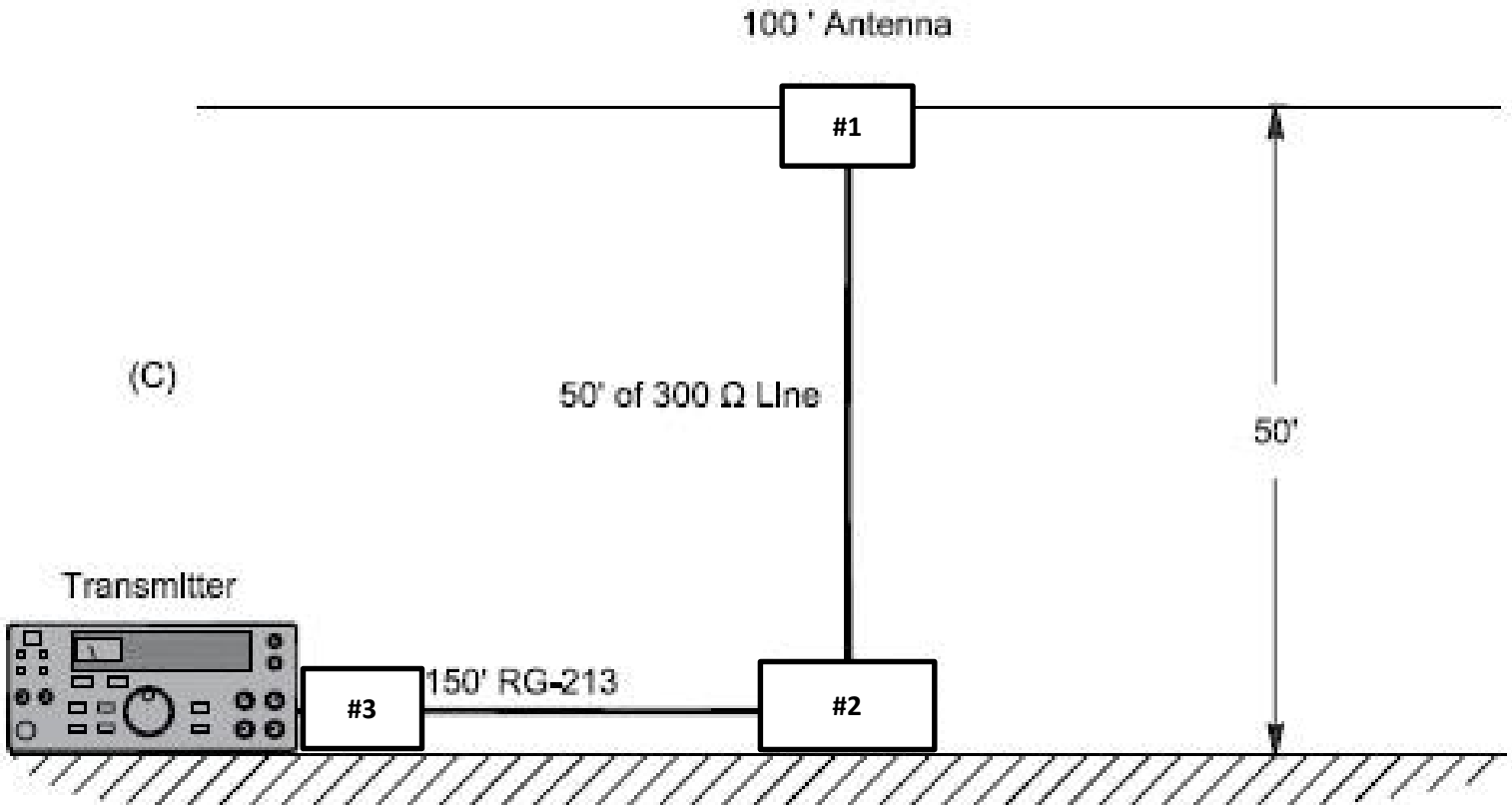
Possible Feedlines - #2



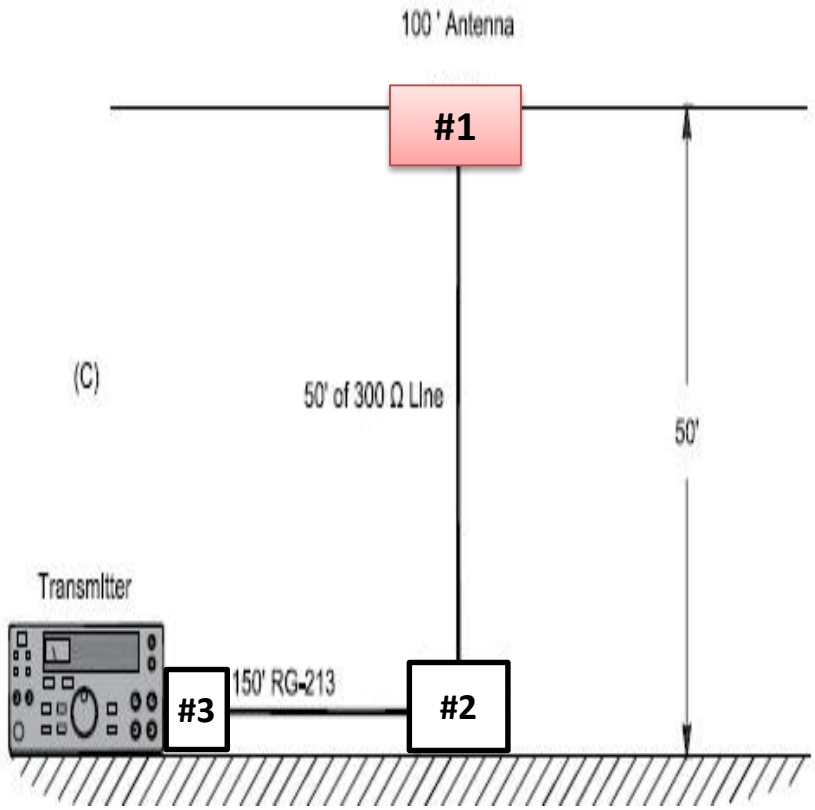
Possible Feedlines - #3



Possible Tuner locations



Location 1 Pros/Cons



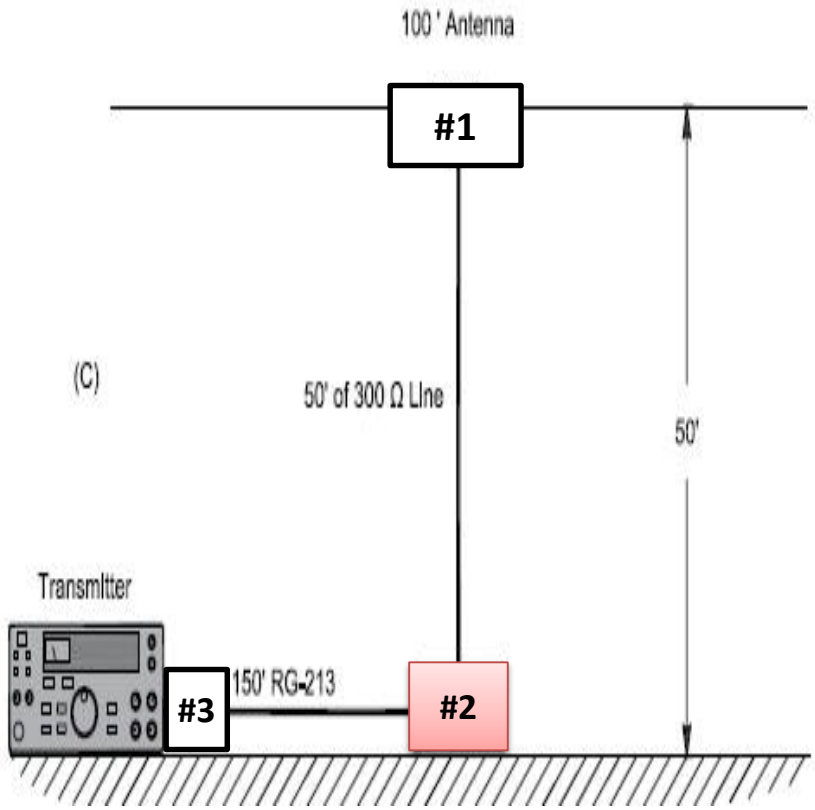
Pros

- Simplest impedance match
- Feedline(s) not part of the variable

Cons

- Remote control needed or tune by hand in the rain
- More cables for tuner
- High-power remote tuners – limited options or $$$$

Location 2 Pros/Cons



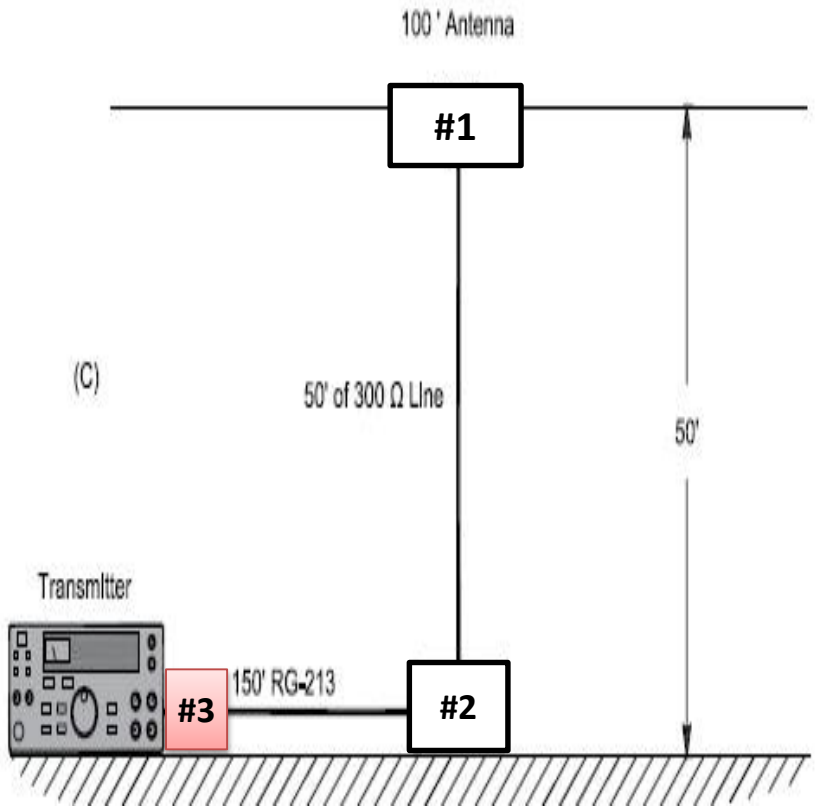
Pros

- Tuner at least at ground level!
- Coax impedance not part of tuning problem (matched 50 ohm)

Cons

- Remote control needed or tune by hand in the rain
- More cables for tuner
- High-power remote tuners – limited options or $$$$
- Ladder line becomes part of the antenna – affects tuning
- Balun at #1 (or not) may affect impedance

Location 3 Pros/Cons



Pros

- Remote control not needed

Cons

- Coax, ladder line, and balun are all part of the complex tuning impedance
- MUCH harder to tune – wider SWRs at high power

Tuners and Loops

- Like a dipole, a loop can be resonant only on a single band (other resonant points usually fall outside additional ham bands*)
- Depending on design, coax and/or ladder line become part of the antenna when tuning
- Tuner in shack
  - Need to tune loop, ladder line, and coax together at once
  - Coax and ladder line each behave differently at different frequencies and add “length” to the loop.
  - Balun required to change from Balanced antenna to Unbalanced feed line
  - Baluns at high SWR and wide impedances and high power can saturate their cores and impact performance
- Best position for tuner is AT THE ANTENNA FEED POINT
  - Eliminates coax as part of the antenna
  - Eliminates extra loss on coax due to high SWR on the line.
  - Short length of ladder line from loop is low impedance with little impact to tuning
- Available tuner options
  - Loops are BALANCED antennas, most Tuners are UNBALANCED
  - The only HF remote tuner capable of 1500w is the MFJ-998RT tuner, which is still Unbalanced and requires a high power balun.
  - High-power, remote tuners are EXPENSIVE

SO NOW WHAT?

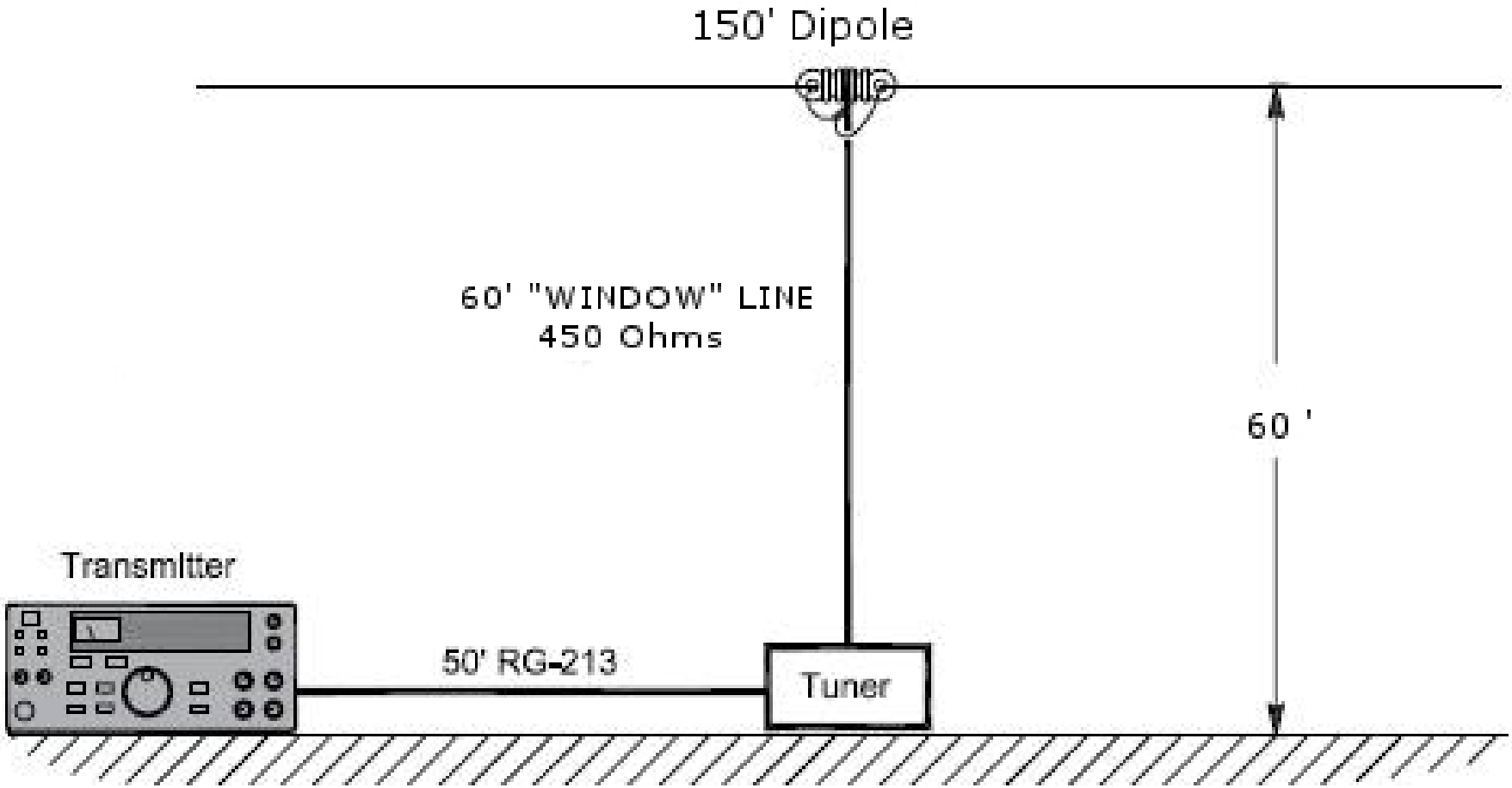
The AJ7B / NR3O remote tuner project

- Randy has a 160m loop and manual tuner home-built and based on the design by Richard Measures (AG6K) in 1990.
- An opportunity to prototype a new tuner for NR3O, while leveraging lessons learned to upgrade Randy's manual tuner into an auto-tuner.
- Few viable commercial options existed
- Opportunity to explore, learn, and refine

Multiband Antenna

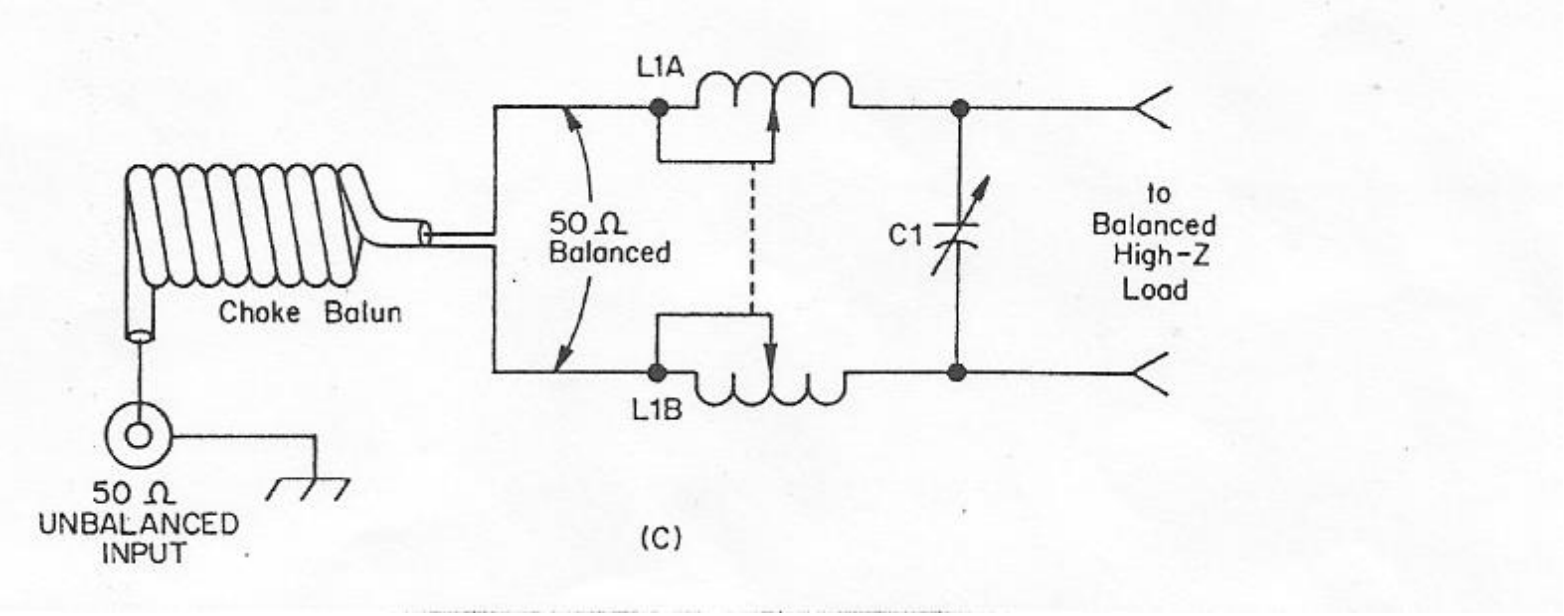
- Richard Measures article meshed in my mind with Maxwell's articles on SWR.

Balanced Balanced Tuner



Balanced Balanced Tuner

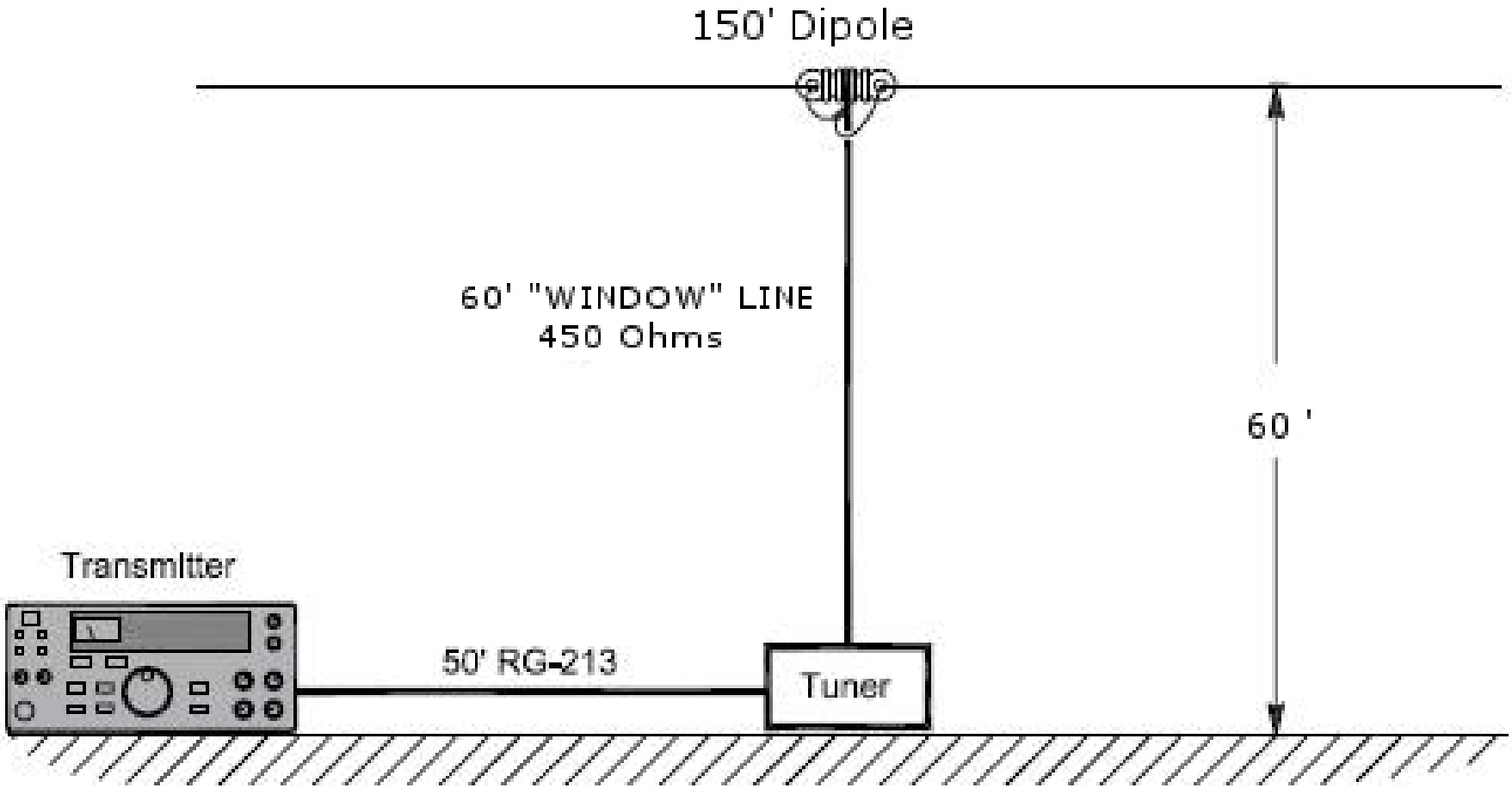
- Basic L-Network Tuner



Balanced Balanced Tuner

- Built tuner in late 1993
- Only manual controls

Balanced Balanced Tuner



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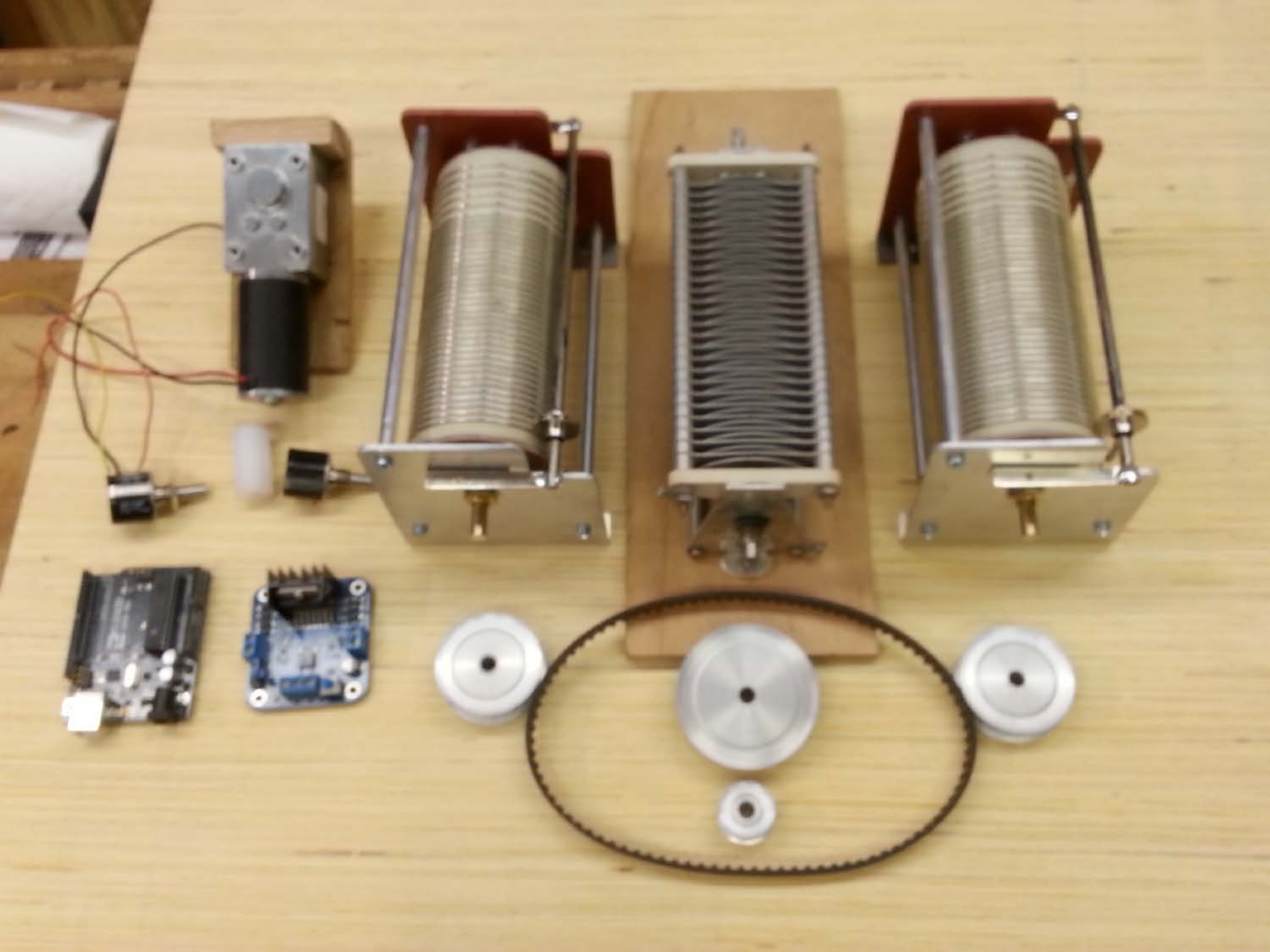
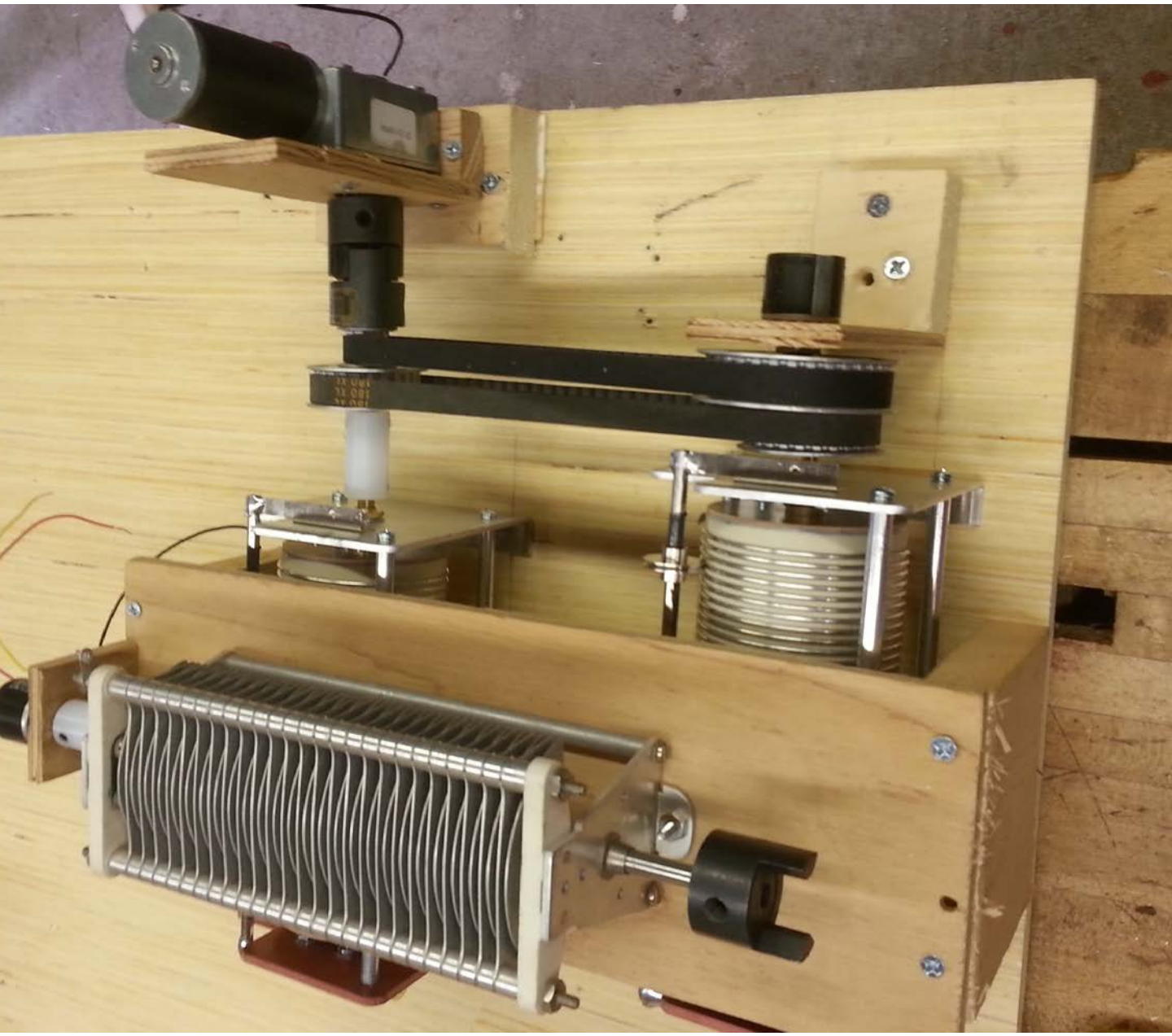
Balanced Balanced Tuner

- Built tuner in late 1993
- Only manual controls
- Tuner does a great job.
- Rob's addition of a 160 is an opportunity




PREMIUM PELLET FUEL



#833

$12.00 EA

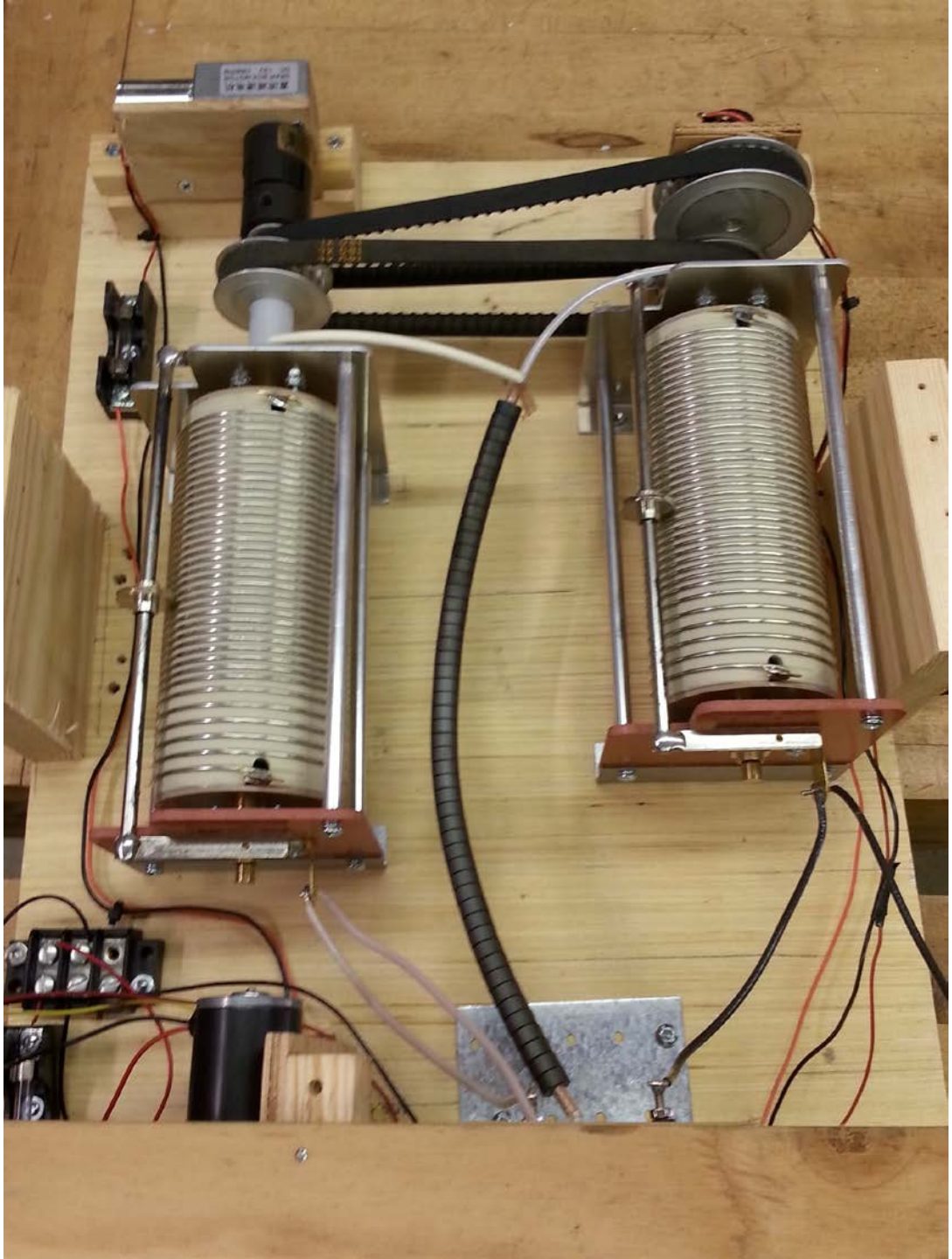
The Wireman Inc.

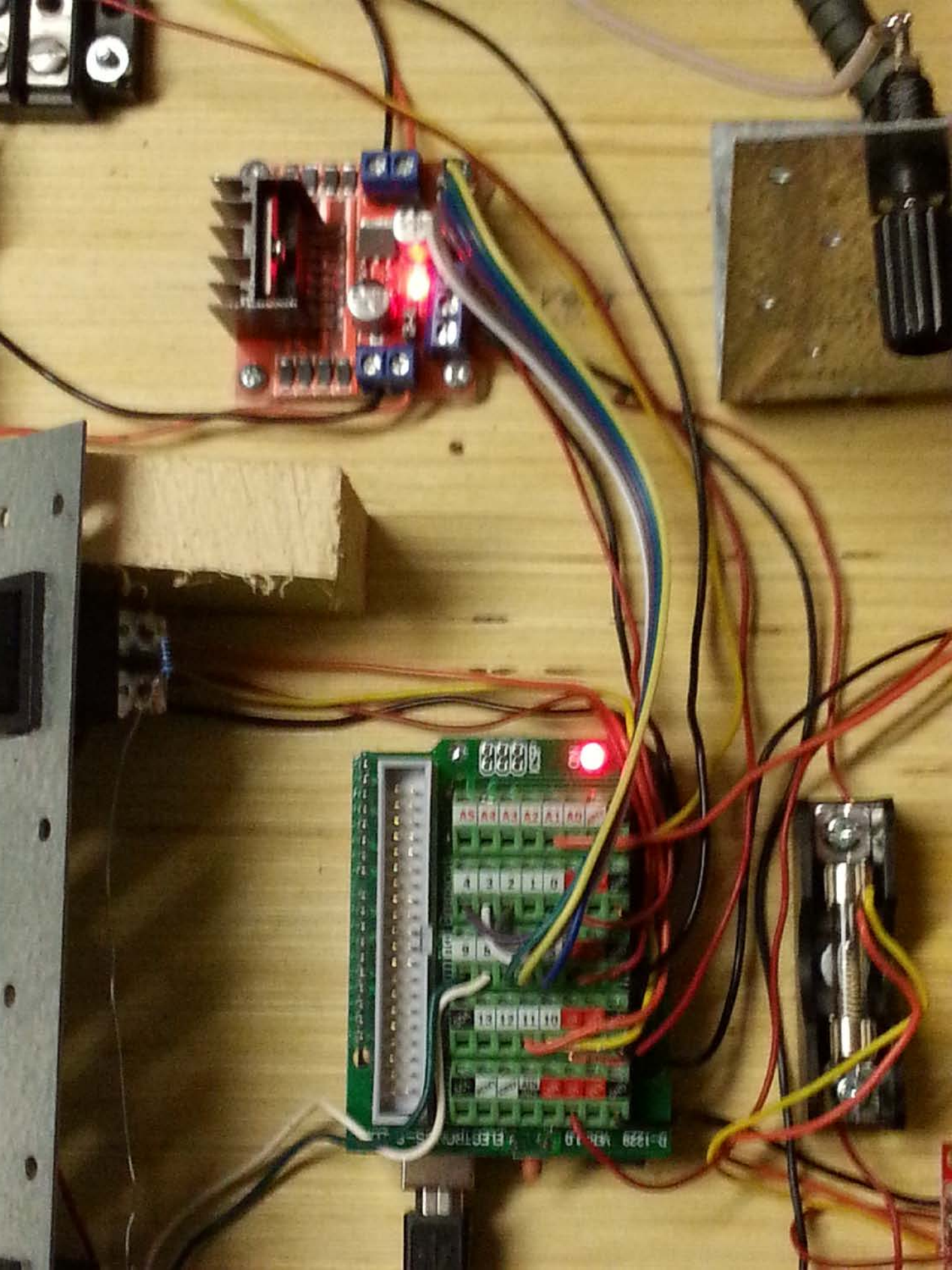
CQ "W2DU" 1:1 BALUN

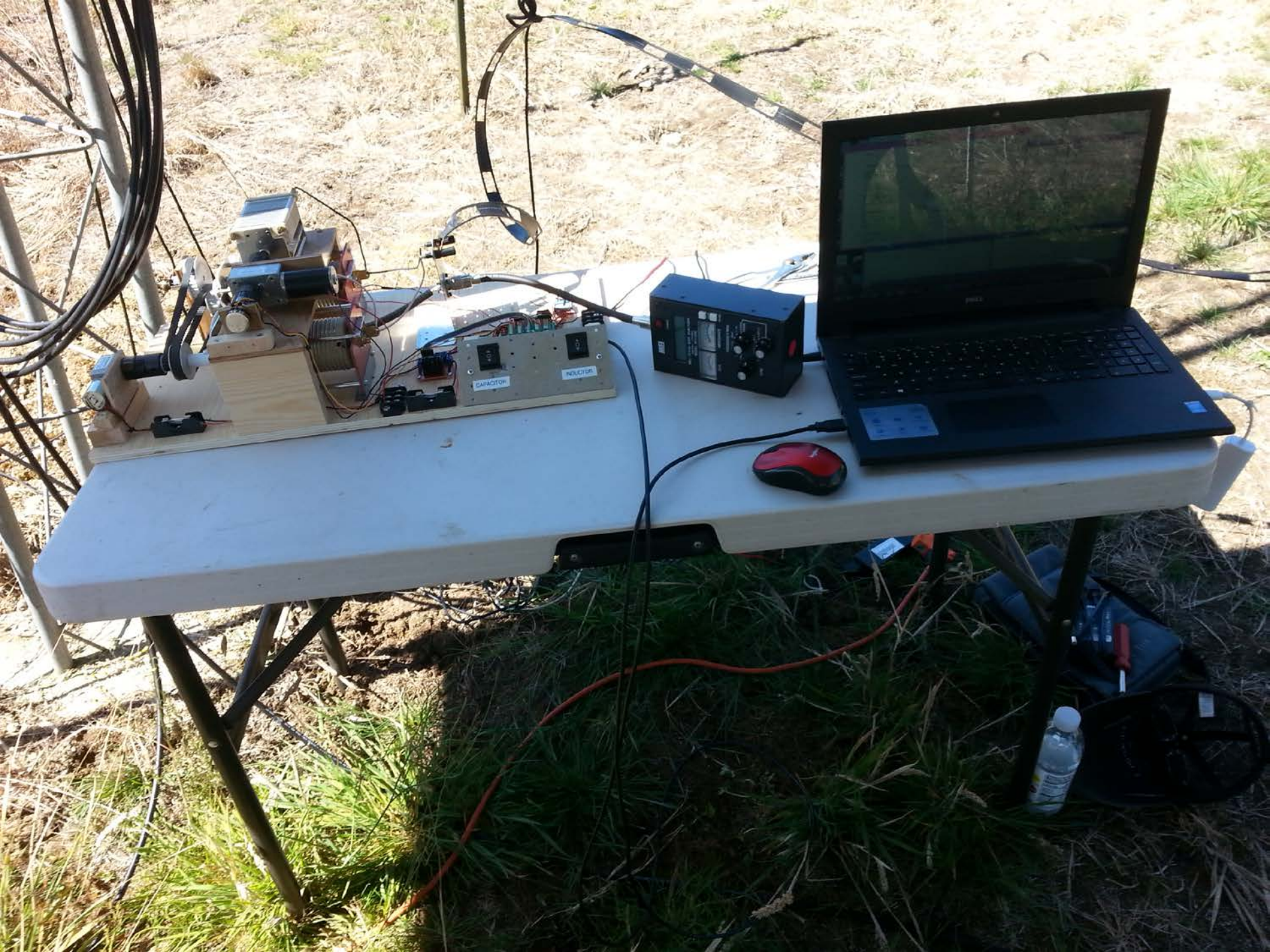
The "guts' of the 823 and 827 baluns

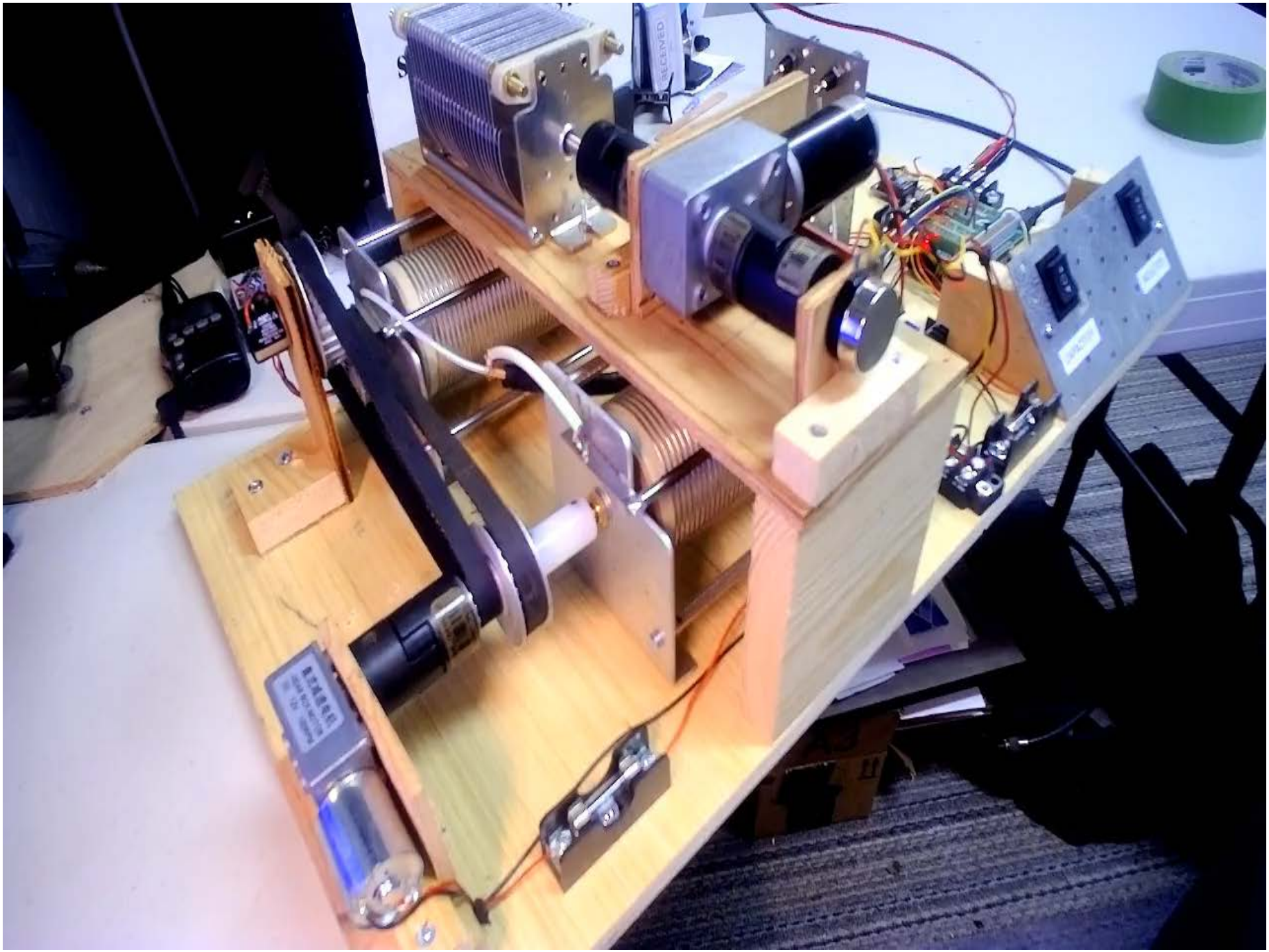
3-30MHz

KIT FORM






CAPACITOR
INDUCTOR



NR3O Tuner
Where do we go from here?

- Future pieces
  - Local control and display for troubleshooting/testing
  - Reliable remote transmitter/receiver
  - Sample/measure SWR, power level, and frequency
  - Automatically scan and “profile” antenna(s)
  - Save tuning parameters in on-board library
  - Setup for full auto-tuning
  - Monitor parameters during operation to trigger protective actions to Amplifier and/or Transceiver
  - Remote controller display to mirror local display (inductor/capacitor position, SWR, power level, etc.)
  - Change from roller inductors to relays/tapped inductors?
  - Make changeable from Balanced to Unbalanced tuner as needed for multiple antennas?
  - Software to integrate with existing radio/amp tuner software/interfaces
  - Does it have viability to be a commercial option or DIY alternative to current products?